a laminated structure of a semiconductor material including an active layer comprising at least one quantum well structure, said laminated structure being formed on a substrate and having at least a portion disposed in said cavity portion;

a low-reflection film formed having a reflectance of 5% or less on one end face of the structure; and

a high-reflection film having a reflectance of 80% or more formed on the other end face of the structure.

Please add new Claim 9-28.

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9. (New) The semiconductor pumping laser device of Claim 1, wherein said device emits light in the 0.98 μm wavelength-band.

10. **(New)** The semiconductor pumping laser device of Claim **9**, wherein the output light of the laser is free of kinks for driving currents up to at least 350 mA, where a kink is a variation of 15% or more in the external differential quantum efficiency of the laser relative to the initial value present when the injected current just exceeds the threshold current.

11. **(New)** The semiconductor pumping laser device of Claim **9**, wherein the output light of the laser is free of kinks for driving currents up to at least 700 mA, where a kink is a variation of 15% or more in the external differential quantum efficiency of the laser relative to the initial value present when the injected current just exceeds the threshold current.

12. **(New)** The semiconductor pumping laser device of Claim **9**, wherein said active layer has no more than two quantum wells, wherein said substrate comprises gallium arsenide, and wherein said laminated structure includes at least gallium and arsenic.

13. **(New)** The semiconductor laser device according to Claim **9**, wherein said device has a transverse light confinement structure with the transverse reflective index difference of about $1\text{x}10^{-2}$ for oscillation modes.

14. **(New)** The semiconductor laser device according to Claim **9**, wherein the coefficient of light confinement to the active layer ranges from 1% to 2%.

15. **(New)** The semiconductor pumping laser device of Claim **1**, wherein the light output of the laser device is coupled to a optic fiber such that light from an optical fiber is fed back to the laser device.

16. (New) The semiconductor pumping laser device of Claim **1**, wherein said active layer has no more than two quantum wells, wherein said substrate comprises gallium arsenide, and wherein said laminated structure includes at least gallium and arsenic.

C2 cont.

17. **(New)** The semiconductor pumping laser device of Claim **16**, wherein said laminated structure further include at least indium and nitrogen.

18. **(New)** The semiconductor pumping laser device of Claim **16**, wherein the output light of the laser is free of kinks for driving currents up to at least 350 mA, where a kink is a variation of 15% or more in the external differential quantum efficiency of the laser relative to the initial value present when the injected current just exceeds the threshold current.

19. **(New)** The semiconductor pumping laser device of Claim **16**, wherein the output light of the laser is free of kinks for driving currents up to at least 700 mA, where a kink is a variation of 15% or more in the external differential quantum efficiency of the laser relative to the initial value present when the injected current just exceeds the threshold current.

20. **(New)** The semiconductor pumping laser device of Claim **16**, wherein the light output of the laser device is coupled to a optic fiber such that light from an optical fiber is fed back to the laser device.

21. **(New)** The semiconductor laser device according to Claim **16**, wherein said device has a transverse light confinement structure with the transverse reflective index

difference of about 1×10^{-2} for oscillation modes.

22. **(New)** The semiconductor laser device according to Claim **16**, wherein the coefficient of light confinement to the active layer ranges from 1% to 2%.

23. **(New)** The semiconductor pumping laser device of Claim **1**, wherein the output light of the laser is free of kinks for driving currents up to at least 350 mA, where a kink is a variation of 15% or more in the external differential quantum efficiency of the laser relative to the initial value present when the injected current just exceeds the threshold current.

C2 cont.

24. **(New)** The semiconductor pumping laser device of Claim **23**, wherein the output light of the laser is free of kinks for driving currents up to at least 700 mA, where a kink is a variation of 15% or more in the external differential quantum efficiency of the laser relative to the initial value present when the injected current just exceeds the threshold current.

25. **(New)** The semiconductor pumping laser device of Claim **23**, wherein the light output of the laser device is coupled to a optic fiber such that light from an optical fiber is fed back to the laser device.

26. **(New)** The semiconductor laser device according to Claim **23**, wherein said device has a transverse light confinement structure with the transverse reflective index difference of about 1×10^{-2} for oscillation modes.

27. **(New)** The semiconductor laser device according to Claim **23**, wherein said active layer comprises no more than two quantum well structures.

28. **(New)** The semiconductor laser device according to Claim **23**, wherein the coefficient of light confinement to the active layer ranges from 1% to 2%.

In the Specification:

Please replace the paragraphs starting at page 1, line 26 and ending at page 6, line 3 with the following paragraph:

-- In the opinion of the inventors, one basic requirement for a pumping laser diode is that its optical output power increase in a substantially smooth manner at high optical output powers as the driving current to the laser diode is increased. However, when the above-described laser diodes are attempted for use in pumping laser applications, the inventors have often found that these laser diodes do not have smooth curves at the high power levels required by pumping applications. The lack of smoothness is evidenced by the presence of kinks in the graph of optical output power versus driving current for the laser diodes.--

Please replace the two paragraphs at page 9, lines 15-23 with the following paragraphs:

--The following semiconductor laser device that oscillates with a wavelength of 0.98 μm was an object of investigation by the inventors as a pumping light source for optical fiber amplifier. This device will now be described with reference to the accompanying drawings. FIG. 1 is a side view showing the semiconductor laser device, and FIG. 2 is a sectional view taken along line II-II of FIG. 1.

The device has a layer structure of a semiconductor material, including a lower clad layer 2 of n-AlGaAs, an active layer 3 of a quantum-well structure made of InGaAs and GaAs, an upper clad layer 4 of p-AlGaAs, and a cap layer 5 of p-GaAs, which are stacked in layers on an n-GaAs substrate 1. A part of the upper clad layer 4 and the cap layer 5 form a mesa structure, and a passivation film 6 of SiN is formed on the lateral of the mesa structure. Further, an upper electrode 7 of Ti/Pt/Au is formed on the cap layer 5 and the passivation film 6, and a lower electrode 8 of AuGe/Ni/Au is formed on the back surface of the substrate 1.

The device A is manufactured in the following manner. The aforesaid layer structure is formed on the n-GaAs substrate by, for example, the MOCVD method, and the upper and lower electrodes are formed on the upper and lower surfaces, respectively, of the layer structure. Thereafter, the resulting structure is cleft with a given cavity length L, a low-reflection film 9 of, e.g., SiN is formed on one end face (front facet) S_1 of the structure, and a high-reflection film 10 of, e.g., SiO_2/Si is formed on the other end face (rear facet) S_2.

In the case of the device A having this mesa structure, it is believed that high optical output can be effectively obtained by increasing the cavity length L. This is because if the cavity length L increases, the influence of heat can be lessened, so that high-optical output can be expected. If the cavity length is too long, however, the differential quantum efficiency of the device A lowers, so that higher current is required for high-optical output operation. Normally, therefore, the cavity length L of the device A with this construction is designed so that the cavity length L is not longer than 1,000 μm.

The inventors hereof examined the current-optical output characteristic for the case where the cavity length L of the device A with the layer structure shown in FIGS. 1 and 2 was adjusted to 800 μm. Thereupon, the characteristic curve of FIG. 3 and the following new knowledge were obtained.

C4 cont'd.

When a driving current (A_1) of about 200 mA was injected, as seen from FIG. 3, a first kink (a_1) was generated in the optical output, and the existing linear relation between the driving current and the optical output disappeared. If the driving current was further increased to a level (A_2) of about 500 mA, a second kink (a_2) was generated in the optical output. Thus, in the case of the device A, the two kinks a_1 and a_2 were generated in the current-optical output characteristic curve as the driving current was increased.

Accordingly, the inventors hereof first closely examined the oscillation spectrum of the device A. The following is a description of the results of the examination.

(1) FIG. 4 shows an oscillation spectrum obtained when the injected current was at about 200 mA.

As seen from this oscillation spectrum, there is a small number of longitudinal modes which oscillate actually in a gain band g. The intensity of a central longitudinal oscillation mode B_0 is 5 dB or more higher than those of side modes B_1 and B_2. As a whole, single longitudinal mode oscillation that is prescribed by the central longitudinal oscillation mode B_0 is dominant.

(2) An oscillation spectrum obtained when the first kink (a_1) was generated indicates that the central longitudinal oscillation mode B_0 jumps to the side mode B_1 at a distance of about 0.4 nm therefrom when the gain band shifts to the longer wavelength side as the temperature of the device rises with the increase of the injected current.

The probability of generation of single longitudinal mode oscillation is related to a spontaneous emission factor (βsp) given by

$$\beta sp = \Gamma \cdot \lambda^4 \cdot K/4\pi^2 \cdot n^3 \cdot V \cdot \delta\lambda, \qquad (1)$$

where Γ is the confinement coefficient of the active layer, λ is an oscillation wavelength, K is a factor reflective of the complexity of the electric field for a transverse mode, n is an equivalent refractive index, V is the volume of the active layer, and $\delta\lambda$ is the half width of the spontaneous emission spectrum. It is believed that the smaller the value βsp, the higher the probability of generation of single longitudinal mode oscillation is.

In the case of the device A, therefore, the oscillation wavelength (λ) is as short as 0.98 μm, so that βsp is lowered in proportion to the fourth power of λ. Accordingly, the device A can be supposed to be able to cause single longitudinal mode oscillation with high probability.

The following problem will be aroused, however, if a module is constructed in a manner such that the device A that undergoes single longitudinal mode oscillation is connected to an optical fiber. A laser beam generated by single longitudinal mode oscillation has its noise properties lowered under the influence of return light from an end portion of the optical fiber. Further, the oscillation of the laser beam is made unstable by the return light. Accordingly, an optical output fetched from the module and monitor current are rendered unstable.

In order to use the device A as a reliable pumping light source for optical fiber amplifier, therefore, it is necessary to solve the above problem that is attributable to single longitudinal mode oscillation.

The result (2) implies the following situation. In consideration of gain differences caused between the longitudinal modes for single longitudinal mode oscillation for the aforesaid reason, the longitudinal mode hopping occur which causes substantial discontinuous fluctuations of the optical output when the gain band shifts to the longer wavelength side in response to temperature rise. When the injected current almost reaches the level A_1, therefore, the current-optical output characteristic loses its linearity, so that the first kink (a_1) is generated.

Then, the inventors hereof observed a far field pattern of the device A and obtained the findings shown in FIG. 5.

In FIG. 5, curve C_1 represents a transverse oscillation mode for the case where the injected current is lower than A_2, and curve C_2 represents a transverse oscillation mode for the case where the injected current is near A_2 (or where the second kink a_2 is generated).

If the injected current increases to A_2, as seen from FIG. 5, unit-modal transverse oscillation modes shift horizontally from the center position of the device A (or undergo beam steering). Thus, the direction of emission of the laser beam changes.

C4 cond.

In the case where the module is constructed by connecting the optical fiber to the device A, therefore, the optical output fetched through the optical fiber fluctuates when the injected current reaches a value approximate to A_2. This is supposed to result in the generation of the second kink (a_2) in the current-optical output characteristic curve.

From these investigations, the inventors discovered that the linearity of the current-optical output characteristic curve can be secured by adjusting the cavity length (L) to a value not smaller than 1200 μm. Preferably, the device has a transverse light confinement structure with the transverse refractive index difference of about 1 x 10^{-2} for oscillation modes, the reflectance of the low-reflection film on the one end face is 5% or less, and the active layer is formed of one or two quantum well structures.--

Please insert the following paragraph between lines 6 and 7 of page 12:

C5

-- InP- and GaInNAs-based semiconductor materials may be used in place of the aforesaid materials for the device A. --

REMARKS

This Amendment is submitted in response to the Office Action Mailed December 6, 2001, wherein the Specification was objected to for not clearly describing FIGS. 1–5 as either being illustrative of the invention or the prior art, wherein FIGS. 1–5 were objected to for lacking a prior art legend, and wherein Claims 1 – 8 were rejected under 35 U.S.C. §103(a) as being obvious over FIGS. 1 and 2 of the application in combination with pages 1 – 6 of the Specification, which the Examiner has viewed as being admissions of prior art by Applicants.